Congressional Notification Profile
DE-PS26-02NT41369

UNIVERSITY COAL RESEARCH PROGRAM, INNOVATICE CONCEPTS PROGRAM
University of Arizona

Background and Technical Information:
Project Title: "Simultaneous Mechanical and Heat Activation: A New Route to Enhance Serpentine Carbonation Reactivity and Lower CO_2 Mineral Sequestration Process Cost."

This project will combine power plant waste heat with coal-grinding equipment to develop a hot-grinding pretreatment approach that can substantially reduce energy consumption and process cost, and create new, pretreated materials capable of trapping carbon dioxide from coal plants. A series of tests, such as atomic composition, will establish which materials exhibit the most carbonation reactivity, and what role, if any, surface area plays in enhancing carbonation reactivity.

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Congressional District: 01 District County: Maricopa

Financial Information:

Length of Contract (months): 12
Government Share: $49,950
Total value of contract: $71,896

DOE Funding Breakdown:
Funds: FY 2002 $49,950

SIMULTANEOUS MECHANICAL AND HEAT ACTIVATION: A NEW ROUTE TO ENHANCE SERPENTINE CARBONATION REACTIVTY AND LOWER CO2 MINERAL SEQUESTRATION PROCESS COST

Sponsoring Organization: Arizona State University
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Public Abstract

Coal can support a large fraction of global energy demands for centuries to come, ***if*** the environmental problems associated with CO2 emissions can be overcome. Unlike other candidate technologies, which propose long-term storage (e.g., ocean and geological sequestration), mineral sequestration permanently disposes of CO2 as geologically stable mineral carbonates. Only benign, naturally occurring materials are formed, eliminating long-term storage and liability issues. Serpentine carbonation is a leading mineral sequestration process candidate, which offers large scale, permanent sequestration. Deposits exceed those needed to carbonate all the CO2 that could be generated from global coal reserves, and mining and milling costs are reasonable (~$4 to $5/ton). Carbonation is exothermic, providing exciting low-cost process potential. The remaining goal is to develop an economically viable process. An essential step in this development is increasing the carbonation reaction rate and degree of completion, without substantially impacting other process costs. Recently, the Albany Research Center (ALRC) has accelerated serpentine carbonation, which occurs naturally over geological time, to near completion in less than an hour. While reaction rates for natural serpentine were found to be too slow for practical application, both heat and mechanical (attrition grinding) pretreatment were found to substantially enhance carbonation reactivity. Unfortunately, these processes are too energy intensive to be cost-effective in their present form.

In this project we shall explore the feasibility of combining power plant waste heat(available up to 200-250 o C), with mechanical activation (i.e., ball milling). This *novel new hot-grinding pretreatment approach* has the potential to

- substantially reduce pretreatment energy consumption and process cost and
- create new, potentially more carbonation reactive, pretreated materials.

High purity lizardite will be used as the model serpentine material for these pilot studies. Hot-ground materials prepared as a function of grinding temperature and time, humidity, and grinding media will be (i) characterized by X-ray powder diffraction and thermogravimetric and differential thermal analysis and (ii) carbonated using the reaction conditions established at the ALRC. Carbon and hydrogen elemental analysis of carbonation products will assess carbonation reactivity. BET analysis will probe the role of surface area in enhancing carbonation reactivity. Materials with the highest carbonation reactivity will be extensively characterized to develop an atomic-level understanding of the structure and composition that best enhances carbonation reactivity. Such understanding will facilitate engineering new materials and processes to enhance

carbonation reactivity and reduce process cost. High-resolution transmission electron microscopy will be integrated with advanced computational modeling to provide key atomic-level insight.

These studies will be complemented by investigations, including infrared and Raman spectroscopy, field-emission scanning electron microscopy, and microprobe analysis, to provide a deeper understanding of the key structural and compositional features that enhance carbonation reactivity